

Amendments to the claims

21 1. (Previously thrice amended) An integrated etch and metal liner process of a substrate including a dielectric layer and covered with a patterned mask material, comprising the steps of:

- a first step of transferring the substrate into a first transfer chamber held at a first pressure below atmospheric pressure;
- a second step of transferring the substrate from the first transfer chamber to an etching chamber and etching according to said patterned mask material through said dielectric layer to an etch stop layer to form a hole in said oxide layer;
- ashing said mask material;
- removing said etch stop layer exposed at a bottom of said hole;
- a third step of transferring the substrate from the first transfer chamber to a second transfer chamber through an intermediate load lock, wherein said first transfer chamber is vacuum isolated from said second transfer chamber throughout said third transferring step;
- a fourth step of transferring said wafer from said second transfer chamber to a metallization chamber without exposing the substrate to an atmospheric pressure;
- depositing a barrier layer in said metallization chamber; and
- depositing a seed layer.

2. (Original) The process of Claim 1, wherein said metal seed layer is a copper seed layer.

3. (Original) The process of Claim 2, wherein said barrier layer comprises tantalum.

4. (Original) The process of Claim 1, wherein at least one of said two depositing steps is a sputtering step.

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5. (Previously four times amended) An integrated etch and metal liner process of a substrate including an etch stop layer covered with a dielectric layer covered with a patterned mask material, comprising the steps of:

etching according to said mask through said dielectric layer to said etch stop layer to form a hole in said dielectric layer;

ashing said mask material;

removing said etch stop layer exposed at a bottom of said hole;

a first step of transferring said substrate to a first transfer chamber maintained at a sub-atmospheric pressure;

a second step of transferring said substrate from said first transfer chamber to a second transfer chamber through an intermediate load lock, wherein said second transfer chamber is isolated from said first transfer chamber throughout said second transferring step;

in a reactor coupled to said second transfer chamber, depositing a barrier layer; and

in a reactor coupled to said second transfer chamber, depositing a metal seed layer;

wherein said substrate is maintained between said etching, ashing and removing steps and throughout said transferring steps at sub-atmospheric pressures.


6. (Original) The process of Claim 5, wherein said barrier layer comprises tantalum.

7. (Original) The process of Claim 5, wherein at least one of said depositing steps is a sputtering step.

8. (Original) The process of Claim 5, wherein ^{which one} said transfer chamber is maintained at a pressure of less than 10^{-6} Torr.

9. (Previously twice amended) An integrated etch and metal liner process of a substrate including a stop layer covered with an oxide layer covered with a patterned photoresist mask,

comprising the steps of:

 a first step of transferring said substrate into a first transfer chamber maintained at a pressure of no more than 1 Torr;

a second step of transferring said substrate from said first transfer chamber to an oxide etch reactor;

in said oxide etch reactor, etching said oxide layer according to said mask to form a hole in said oxide layer;

a third step of transferring said substrate from said oxide etch reactor through said first transfer chamber to a second transfer chamber isolated from and first transfer chamber throughout said third transferring step and maintained at a pressure of no more than 10^{-6} Torr; and

a fourth step of transferring said substrate from said second transfer chamber to at least one reactor to deposit a layer in said hole.

10. (Original) The process of Claim 9, further comprising ashing said photoresist layer in said oxide etch reactor.

11. (Previously amended) The process of Claim 9, further comprising:
a fifth step of transferring said substrate from said oxide etch reactor through said first transfer chamber to a plasma ashing reactor attached to said first transfer chamber; and
in said plasma ashing reactor, ashing said photoresist layer;
wherein said third step of transferring comprises transferring said substrate from said plasma ashing reactor through said first transfer chamber to said second transfer chamber.

12 – 13. (Canceled)

14. (Previously twice amended) An integrated process performed in processing reactors

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connected to first and second central vacuum transfer chambers held at pressures of no more than 1 Torr, said first and second central vacuum transfer chambers being linked by a doubly gated vacuum passageway, said processing reactors, said first and second central vacuum transfer chambers, and said vacuum passageway being formed on a single platform, said process comprising the steps of:

loading into said first central vacuum transfer chamber through a load lock a substrate having a dielectric layer covered by a patterned resist material;

in at least one etching reactor connected to said first central vacuum transfer chamber through a respective slit valve, etching said dielectric layer in said substrate according to said patterned resist material to form a hole therethrough and thereafter ashing said resist material;

transferring said substrate through said doubly gated vacuum passageway from said first central vacuum transfer chamber to said second central vacuum transfer chamber while continuing to vacuum isolate said first and second central transfer chambers from each other;

in at least one deposition reactor connected to said second central vacuum transfer chamber through a respective slit valve, depositing a liner layer on sides of said hole;

wherein said substrate is not exposed to atmospheric pressure between said etching step and said depositing step.

15. (Original) The process of Claim 14, wherein said liner layer includes a barrier layer and a copper seed layer.

16. (Original) The process of Claim 14, wherein said at least one deposition reactor includes a sputter reactor with a copper target for depositing said copper seed layer.

17. (Original) The process of Claim 14, wherein said at least one etching reactor includes an etch reactor for etching said dielectric layer and an ashing reactor for ashing said resist material.

19. (Previously amended) The process of Claim 14, wherein said at least one etching reactor includes an etch reactor for etching said dielectric layer and an ashing reactor for ashing said resist material and wherein said at least one deposition reactor includes a first sputter reactor for depositing at least a part of a barrier layer and a second sputter reactor for depositing a copper seed layer.

20. (Previously amended) The process of Claim 14, wherein said second central vacuum transfer chamber is held at a pressure of no more than 10^{-6} Torr.

22. (Previously added) The process of Claim 1, wherein said etching is performed using a fluorine-based chemistry.

23. (Currently amended and previously added) The process of Claim 1, wherein said intermediate load lock is doubly gated and includes a pedestal for supporting said substrate which is accessible by two substrate-handling robots located respectively in said first and transfer chambers, whereby said first and second transfer chambers are vacuum isolated from each other during transfer of said substrate through said intermediate load lock during said third transferring step.

24. (Previously added) The process of Claim 5, wherein said etching step uses a fluorine-containing etching gas.

25. (Currently amended and previously added) The process of Claim 5, wherein said intermediate load lock is doubly gated and includes a pedestal for supporting said substrate which is accessible by two substrate-handling robots located respectively in said first and second transfer chambers, whereby said first and second transfer chambers are vacuum isolated from

each other during transfer of said substrate through said intermediate load lock during said second transferring step.

26. (Previously added) The process of Claim 9, wherein said etching step uses a fluorine-containing etching gas.

27. (Currently twice amended and previously added) The process of Claim 9, wherein said first and second transfer chambers are isolated by a doubly gated load lock through which said substrate is transferred in said third transferring step.

28. (Previously added) The process of Claim 14, wherein said etching step uses a fluorine-containing etching gas.

29. (Previously added) The process of Claim 23, further comprising throughout said third transferring step:

maintaining said first transfer chamber at a first pressure; and
maintaining said second transfer chamber at a second pressure lower than said first pressure.


30. (Previously added) The process of Claim 25, further comprising throughout said transferring step:

maintaining said first transfer chamber at a first pressure; and
maintaining said second transfer chamber at a second pressure lower than said first pressure.

31. (Previously added) The process of Claim 27, further comprising throughout said third transferring step:

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 maintaining said first transfer chamber at a first pressure; and
maintaining said second transfer chamber at a second pressure lower than said first
pressure.
